National Semiconductor

November 1994

# 54F/74F157A
# Quad 2-Input Multiplexer

## General Description

The 'F157A is a high-speed quad 2-input multiplexer. Four bits of data from two sources can be selected using the common Select and Enable inputs. The four outputs present the selected data in the true (non-inverted) form. The 'F157A can also be used to generate any four of the 16 different functions to two variables.

## Features

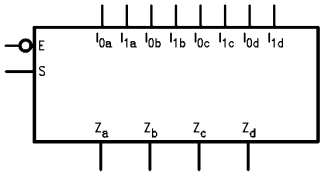
- Guaranteed 4000V minimum ESD protection

| Commercial | Military | Package Number | Package Description |
|---|---|---|---|
| 74F157APC | | N16E | 16-Lead (0.300″ Wide) Molded Dual-In-Line |
| | 54F157ADM (Note 2) | J16A | 16-Lead Ceramic Dual-In-Line |
| 74F157ASC (Note 1) | | M16A | 16-Lead (0.150″ Wide) Molded Small Outline, JEDEC |
| 74F157ASJ (Note 1) | | M16D | 16-Lead (0.300″ Wide) Molded Small Outline, EIAJ |
| | 54F157AFM (Note 2) | W16A | 16-Lead Cerpack |
| | 54F157ALM (Note 2) | E20A | 20-Lead Ceramic Leadless Chip Carrier, Type C |

**Note 1:** Devices also available in 13″ reel. Use suffix = SCX and SJX.

**Note 2:** Military grade device with environmental and burn-in processing. Use suffix = DMQB, FMQB and LMQB.

## Logic Symbols

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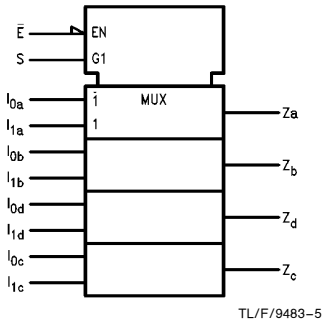
**IEEE/IEC**

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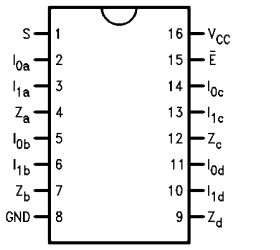
## Connection Diagrams

**Pin Assignment for DIP, SOIC and Flatpak**

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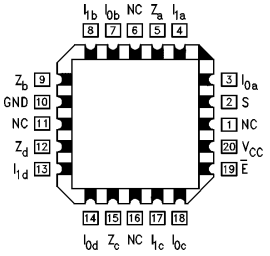
**Pin Assignment for LCC**

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RRD-B30M75/Printed in U. S. A.

## Unit Loading/Fan Out

| Pin Names | Description | 54F/74F | |
|---|---|---|---|
| | | U.L. HIGH/LOW | Input $I_{IH}/I_{IL}$ Output $I_{OH}/I_{OL}$ |
| $I_{0a}$–$I_{0d}$ | Source 0 Data Inputs | 1.0/1.0 | 20 $\mu$A/−0.6 mA |
| $I_{1a}$–$I_{1d}$ | Source 1 Data Inputs | 1.0/1.0 | 20 $\mu$A/−0.6 mA |
| $\overline{E}$ | Enable Input (Active LOW) | 1.0/1.0 | 20 $\mu$A/−0.6 mA |
| S | Select Input | 1.0/1.0 | 20 $\mu$A/−0.6 mA |
| $Z_a$–$Z_d$ | Outputs | 50/33.3 | −1 mA/20 mA |

## Functional Description

The 'F157A is a quad 2-input multiplexer. It selects four bits of data from two sources under the control of a common Select input (S). The Enable input ($\overline{E}$) is active LOW. When $\overline{E}$ is HIGH, all of the outputs (Z) are forced LOW regardless of all other inputs. The 'F157A is the logic implementation of a 4-pole, 2-position switch where the position of the switch is determined by the logic levels supplied to the Select input. The logic equations for the outputs are shown below:

$$Z_n = \overline{E} \bullet (I_{1n}\, S + I_{0n}\, \overline{S})$$

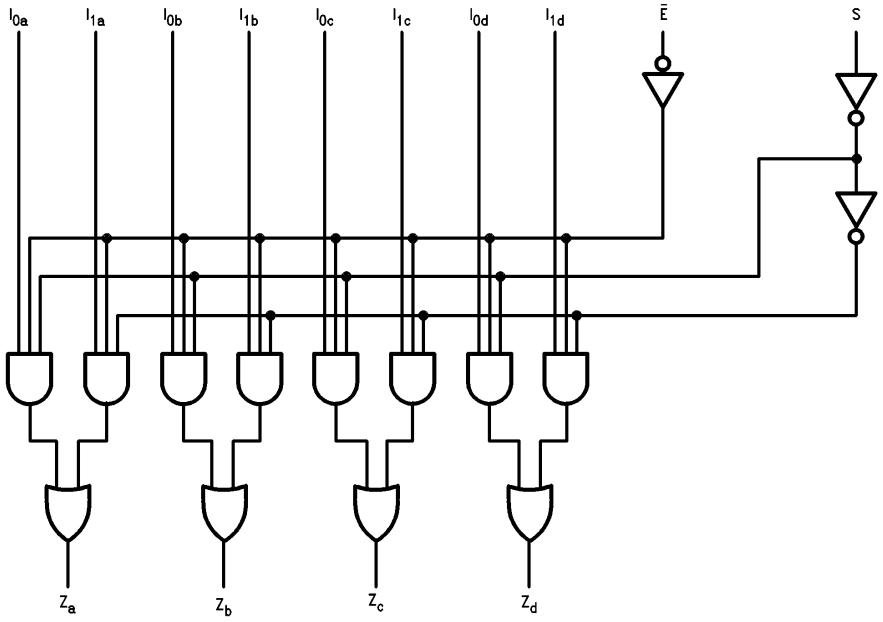
A common use of the 'F157A is the moving of data from two groups of registers to four common output busses. The particular register from which the data comes is determined by the state of the Select input. A less obvious use is as a function generator. The 'F157A can generate any four of the 16 different functions of two variables with one variable common. This is useful for implementing highly irregular logic.

## Truth Table

| Inputs | | | | Output |
|---|---|---|---|---|
| $\overline{E}$ | S | $I_0$ | $I_1$ | Z |
| H | X | X | X | L |
| L | H | X | L | L |
| L | H | X | H | H |
| L | L | L | X | L |
| L | L | H | X | H |

H = HIGH Voltage Level
L = LOW Voltage Level
X = Immaterial

## Logic Diagram

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Please note that this diagram is provided only for the understanding of logic operations and should not be used to estimate propagation delays.

## Absolute Maximum Ratings (Note 1)

**If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.**

| | |
|---|---|
| Storage Temperature | −65°C to +150°C |
| Ambient Temperature under Bias | −55°C to +125°C |
| Junction Temperature under Bias | −55°C to +175°C |
| Plastic | −55°C to +150°C |
| $V_{CC}$ Pin Potential to Ground Pin | −0.5V to +7.0V |
| Input Voltage (Note 2) | −0.5V to +7.0V |
| Input Current (Note 2) | −30 mA to +5.0 mA |
| Voltage Applied to Output in HIGH State (with $V_{CC}$ = 0V) | |
| Standard Output | −0.5V to $V_{CC}$ |
| TRI-STATE® Output | −0.5V to +5.5V |
| Current Applied to Output in LOW State (Max) | twice the rated $I_{OL}$ (mA) |
| ESD Last Passing Voltage (Min) | 4000V |

**Note 1:** Absolute maximum ratings are values beyond which the device may be damaged or have its useful life impaired. Functional operation under these conditions is not implied.

**Note 2:** Either voltage limit or current limit is sufficient to protect inputs.

## Recommended Operating Conditions

| | |
|---|---|
| Free Air Ambient Temperature | |
| Military | −55°C to +125°C |
| Commercial | 0°C to +70°C |
| Supply Voltage | |
| Military | +4.5V to +5.5V |
| Commercial | +4.5V to +5.5V |

## DC Electrical Characteristics

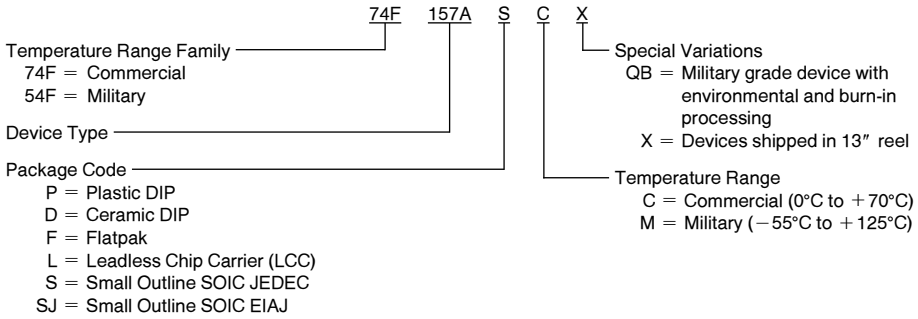
| Symbol | Parameter | | 54F/74F | | | Units | $V_{CC}$ | Conditions |
|---|---|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | | | |
| $V_{IH}$ | Input HIGH Voltage | | 2.0 | | | V | | Recognized as a HIGH Signal |
| $V_{IL}$ | Input LOW Voltage | | | | 0.8 | V | | Recognized as a LOW Signal |
| $V_{CD}$ | Input Clamp Diode Voltage | | | | −1.2 | V | Min | $I_{IN}$ = −18 mA |
| $V_{OH}$ | Output HIGH Voltage | 54F 10% $V_{CC}$ | 2.5 | | | V | Min | $I_{OH}$ = −1 mA |
| | | 74F 10% $V_{CC}$ | 2.5 | | | | | $I_{OH}$ = −1 mA |
| | | 74F 5% $V_{CC}$ | 2.7 | | | | | $I_{OH}$ = −1 mA |
| $V_{OL}$ | Output LOW Voltage | 54F 10% $V_{CC}$ | | | 0.5 | V | Min | $I_{OL}$ = 20 mA |
| | | 74F 10% $V_{CC}$ | | | 0.5 | | | $I_{OL}$ = 20 mA |
| $I_{IH}$ | Input HIGH Current | 54F | | | 20.0 | μA | Max | $V_{IN}$ = 2.7V |
| | | 74F | | | 5.0 | | | |
| $I_{BVI}$ | Input HIGH Current Breakdown Test | 54F | | | 100 | μA | Max | $V_{IN}$ = 7.0V |
| | | 74F | | | 7.0 | | | |
| $I_{CEX}$ | Output HIGH Leakage Current | 54F | | | 250 | μA | Max | $V_{OUT}$ = $V_{CC}$ |
| | | 74F | | | 50 | | | |
| $V_{ID}$ | Input Leakage Test | 74F | 4.75 | | | V | 0.0 | $I_{ID}$ = 1.9 μA All Other Pins Grounded |
| $I_{OD}$ | Output Leakage Circuit Current | 74F | | | 3.75 | μA | 0.0 | $V_{IOD}$ = 150 mV All Other Pins Grounded |
| $I_{IL}$ | Input LOW Current | | | | −0.6 | mA | Max | $V_{IN}$ = 0.5V |
| $I_{OS}$ | Output Short-Circuit Current | | −60 | | −150 | mA | Max | $V_{OUT}$ = 0V |
| $I_{CCH}$ | Power Supply Current | | | 15 | 23 | mA | Max | $V_O$ = HIGH |
| $I_{CCL}$ | Power Supply Current | | | 15 | 23 | mA | Max | $V_O$ = LOW |

## AC Electrical Characteristics

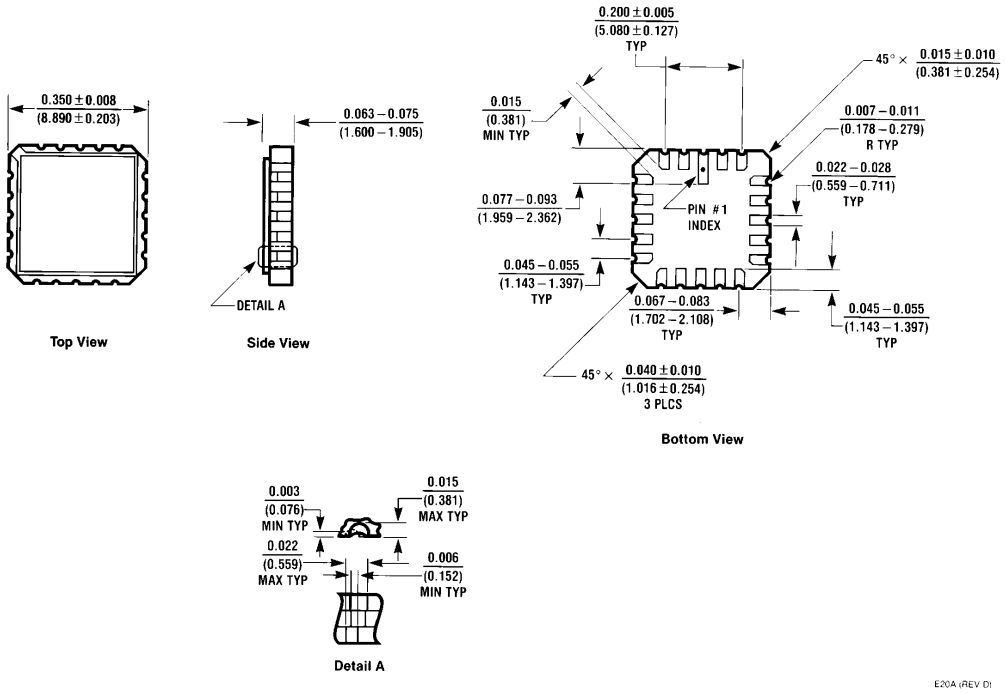
| Symbol | Parameter | 74F $T_A = +25°C$, $V_{CC} = +5.0V$, $C_L = 50$ pF | | | 54F $T_A$, $V_{CC}$ = Mil, $C_L = 50$ pF | | 74F $T_A$, $V_{CC}$ = Com, $C_L = 50$ pF | | Units |
|---|---|---|---|---|---|---|---|---|---|
| | | Min | Typ | Max | Min | Max | Min | Max | |
| $t_{PLH}$ | Propagation Delay | 4.0 | 7.0 | 10.0 | 4.0 | 12.0 | 4.0 | 11.0 | ns |
| $t_{PHL}$ | S to $Z_n$ | 3.0 | 5.0 | 7.0 | 3.0 | 9.0 | 3.0 | 8.0 | |
| $t_{PLH}$ | Propagation Delay | 5.0 | 7.0 | 9.5 | 5.0 | 13.0 | 5.0 | 11.0 | ns |
| $t_{PHL}$ | $\overline{E}$ to $Z_n$ | 2.5 | 4.5 | 6.5 | 2.5 | 7.5 | 2.5 | 7.0 | |
| $t_{PLH}$ | Propagation Delay | 2.5 | 4.5 | 6.0 | 2.5 | 7.5 | 2.5 | 6.5 | ns |
| $t_{PHL}$ | $I_n$ to $Z_n$ | 2.5 | 4.0 | 5.5 | 1.5 | 7.5 | 2.0 | 7.0 | |

## Ordering Information

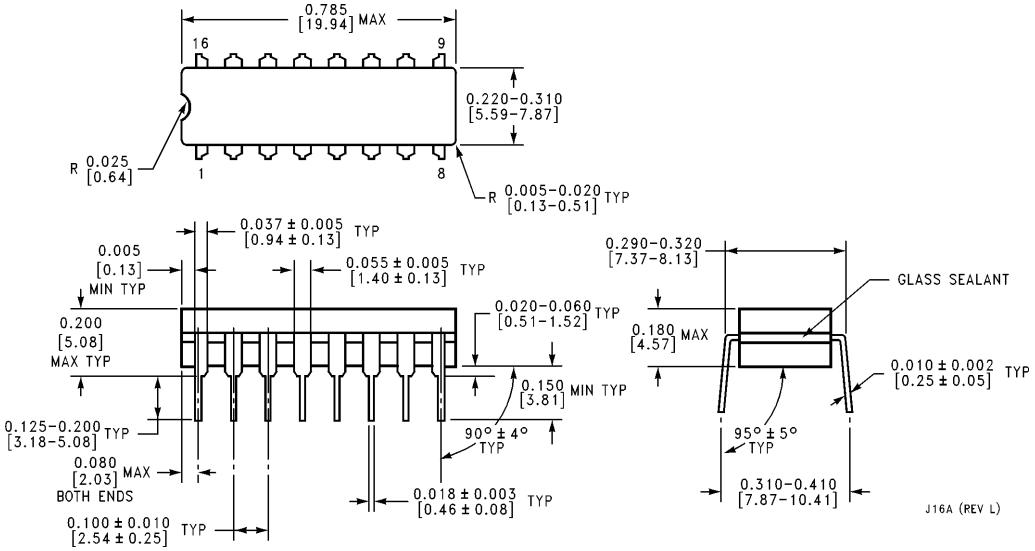
The device number is used to form part of a simplified purchasing code where the package type and temperature range are defined as follows:



## Physical Dimensions inches (millimeters)

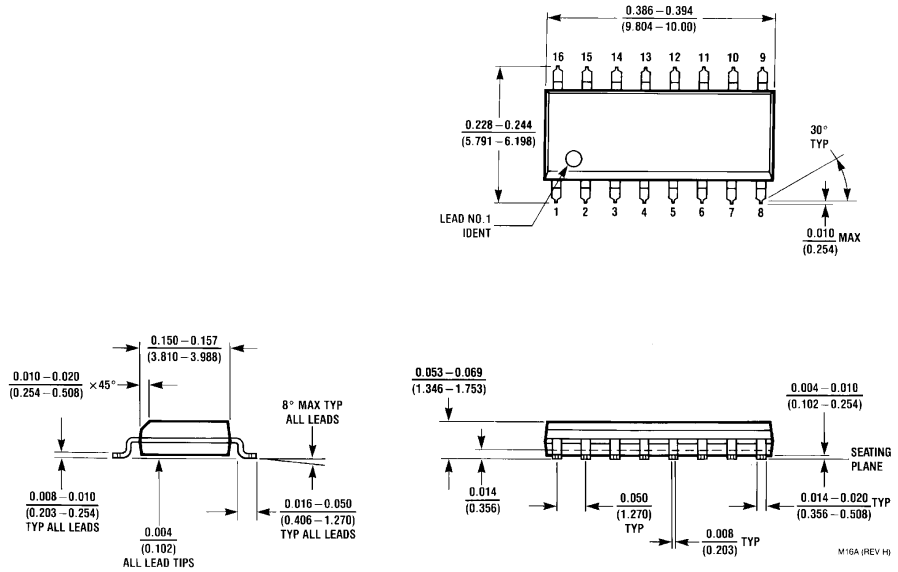



**20-Lead Ceramic Leadless Chip Carrier (L)**
**NS Package Number E20A**



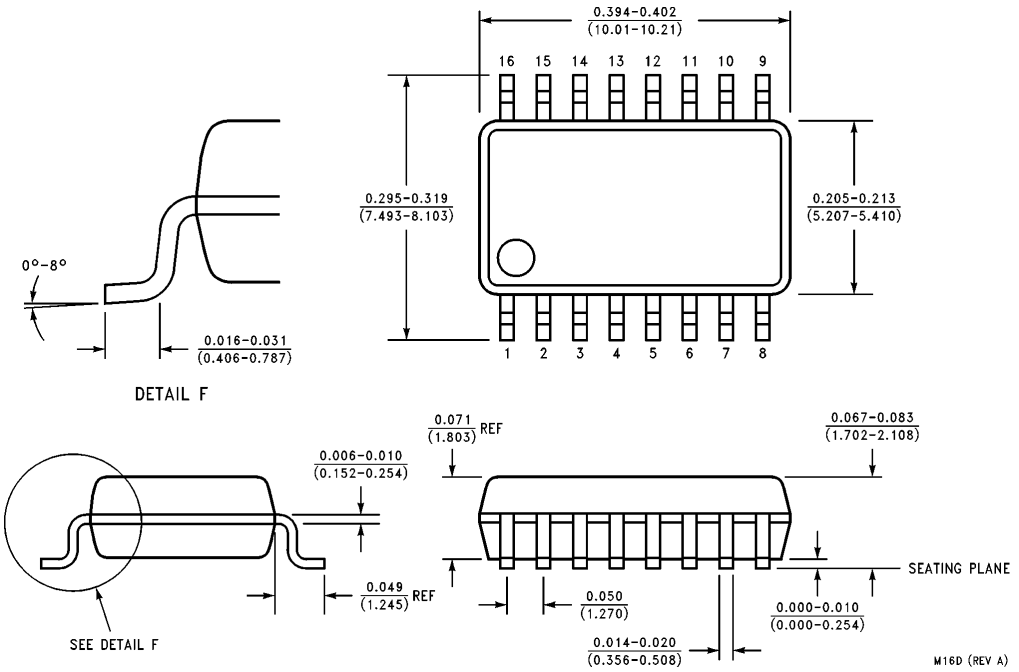

**16-Lead Ceramic Dual In-Line Package (D)**
**NS Package Number J16A**

## Physical Dimensions inches (millimeters) (Continued)

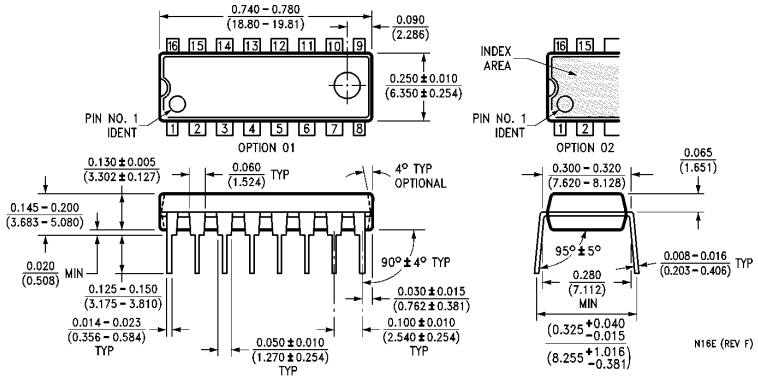



**16-Lead (0.150″ Wide) Molded Small Outline Package, JEDEC (S)**
**NS Package Number M16A**

## Physical Dimensions inches (millimeters) (Continued)

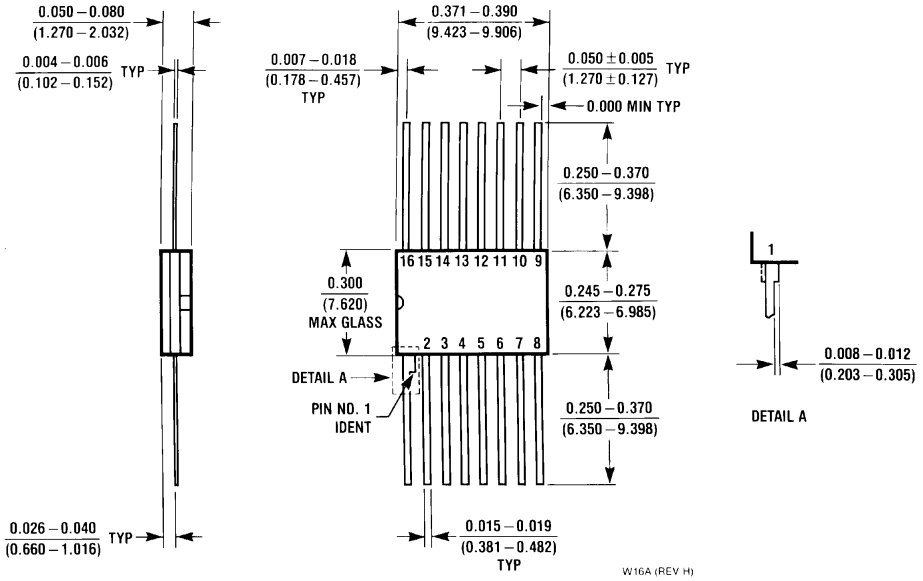



**16-Lead (0.300″ Wide) Molded Small Outline Package, EIAJ (SJ)**
**NS Package Number M16D**




**16-Lead (0.300″ Wide) Molded Dual In-Line Package (P)**
**NS Package Number N16E**

## Physical Dimensions inches (millimeters) (Continued)




**16-Lead Ceramic Flatpak (F)**
**NS Package Number W16A**

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